Center Innovation Fund: GSFC CIF

Variable Emissive Smart Radiator for Dynamic Thermal Control

Completed Technology Project (2016 - 2018)

Project Introduction

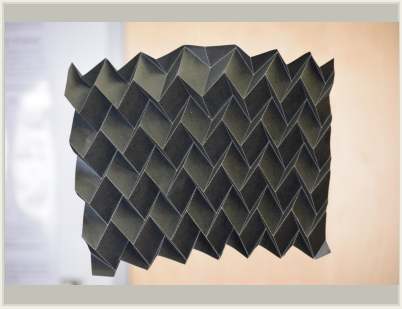
Trending towards reduced power and mass budget on satellites with a longer mission life, there is a need for a reliable thermal control system that is more efficient and cost-effective. By developing a passive, multifunctional, modulating multilayered coating based on the thermochromic material, VO2, a "smart" radiator device (SRD) will allow for thermal control with a decrease in the spacecraft power budget. The objective of this work is to validate multimaterial-layered films deposited via conventional sputtering methods and Atomic Layer Deposition (ALD) to lower the emissive transition point of VO2 and demonstrate the applicability of depositing on novel three dimensional geometries.

The objective of this work is to demonstrate multimaterial-layered films deposited via conventional sputtering methods and ALD and its benefit to GSFC in providing a manufacturing method to meet NASA's Nanotechnology Roadmap. The Nanotechnology Roadmap is broken down into four major themes where the work we are proposing falls under the Engineered Materials & Structures category. Within this category we seek to develop enabling thin-film technologies that facilitate the current state of the art in coatings specifically in thermal protection for the full spectrum of spacecraft platforms from large structures to 1 U CubeSats. Passive thermal films of vanadium oxide, VO_2, have the unique ability to transition from a semiconductor to a metal state at a specific temperature with a change in emissivity. This transition occurs at 68 C with the emissivity changing from e = .4 to e = .9.

In order to tune lower the transition state temperature switch point while increasing the emissivity delta a multi-layered structure is proposed.

Anticipated Benefits

As miniaturized science platforms continue to be an integral part of NASA's missions in the form of CubeSats, novel thermal control methodologies must be applied such that they do not burden the mass and power budget while allowing for an extended mission lifespan. The temperature of a satellite is controlled corresponding to the requirements for the payload and the platform. Launch cost is proportional to a satellite's mass and is therefore the largest development driver. Tending towards the miniaturized platform, typical thermal control systems including heat pipes and radiators are large and heavy. Mulit-layered thermal films based on VO2 as smart radiator devices (SRD) are critical functional thermal control surfaces that decrease the overall spacecraft power budget by being lightweight and passive.



Radiator Concept

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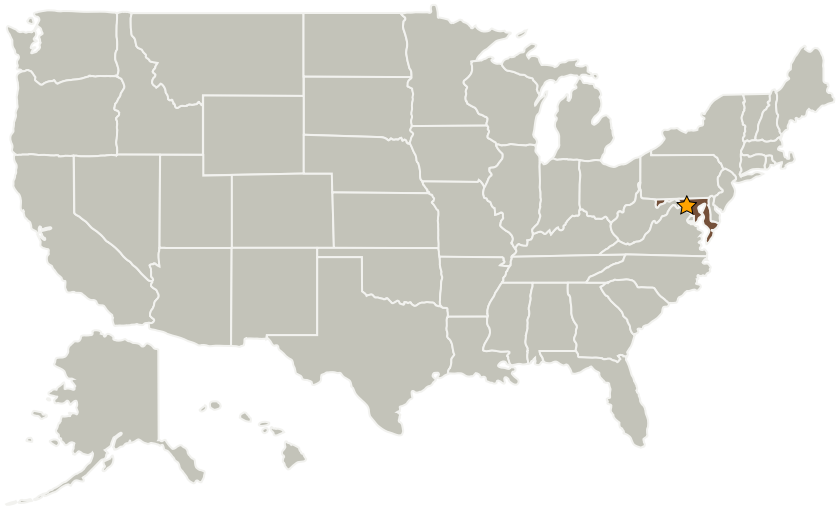
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Innovation Fund: GSFC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Peter M Hughes

Project Managers:

Charles D Butler
Michael A Johnson

Principal Investigator:

Vivek H Dwivedi

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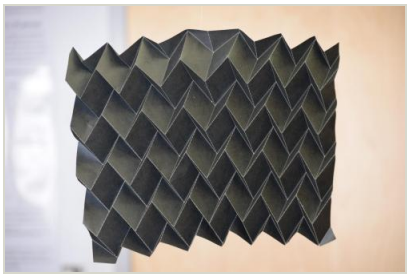
Images



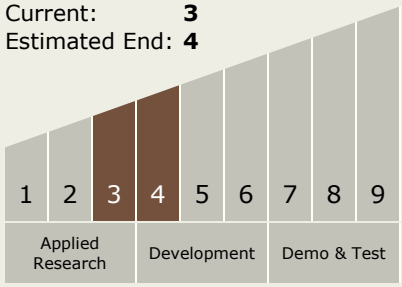
Radiator Concept
Radiator Concept
(https://techport.nasa.gov/image/27757)

Project Website:

http://aetd.gsfc.nasa.gov/

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.3 Heat Rejection and Storage

Target Destinations

Others Inside the Solar System, Outside the Solar System, Foundational Knowledge

Supported Mission Type

Push